DATA QUALITY SUMMARY REPORT FOR PMS LASAIR OPTICAL PARTICLE COUNTER DATA COLLECTED BY SONOMA TECHNOLOGY, INC., DURING THE CALIFORNIA REGIONAL $PM_{10}/PM_{2.5}$ AIR QUALITY STUDY

By:
Nicole P. Hyslop
Steven G. Brown
Courtney A. Gorin
Hilary R. Hafner
Sonoma Technology, Inc.
1360 Redwood Way, Suite C
Petaluma, CA 94954-1169

Prepared for:
San Joaquin Valleywide Air Pollution Study Agency
c/o Karen Magliano
California Air Resources Board
1001 "I" Street
Sacramento, California 95814

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1. INTRODUCTION AND OBJECTIVES

The purpose of this Data Quality Summary Report is to provide data users with an understanding of the quality of PMS Lasair optical particle counter (OPC) data collected by Sonoma Technology, Inc. (STI) for the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CRPAQS). **Table O-1** summarizes the operating sites and times for PMS Lasair OPC measurements during CRPAQS. This report provides summary information on data completeness, lower quantifiable limit (LQL), accuracy, and precision. The PMS Lasair OPC provided a medium-sized particle distribution via count information for 8 size-selective bins with a 5-minute time resolution. The 5-minute data were also averaged to 60-minute concentrations. Data completeness was calculated based on data delivered to ARB; the start date/time indicates the beginning of valid data, continuous until the stop date/time.

Table O-1. Location and duration of PMS Lasair OPC measurements performed by STI during CRPAQS.

Site	Start Date/Time (PST)	Stop Date/Time (PST)
Angiola Trailer	3/30/00 14:40	2/16/01 20:55

Several other documents are available from which to obtain information about the CRPAQS field study and data processing. Sampling locations are described in Wittig et al. (2003). Quality control screening procedures are summarized by Hafner et al. (2003). Results of systems and performance audits and intercomparisons are provided by Bush et al. (2001). No data quality objectives (DQOs) for the PMS Lasair OPC were available.

2. DATA COMPLETENESS

Data completeness for the PMS Lasair OPC is shown in **Table O-2**. Data capture quantifies the percentage of total records received versus the number expected during the “period of operation” defined by the start and stop dates/times in Table O-1; the start date/time is the first instance of valid data, and the period of operation is continuous until the stop date/time. The number of valid data points is divided by the number of captured data points to calculate the data recovery. Validity is defined for this calculation as any data point that has a quality control flag of V0 (valid) or V1 (valid but comprised wholly or partially of below-MDL data). Details of data validation are included in Hafner et al. (2003). For some of the sites, the data completeness information for several wavelengths (bins) was nearly identical; thus, the results for these calculations were combined. In these cases, the numbers of records and percents are per wavelength (bin).

Table O-2. PMS Lasair OPC data completeness values for the Angiola Trailer.

Monitoring Site	Bin	Total No. of Records	No. of Expected Records	Percent Capture[a]	No. of Valid Records	Percent Recovery[b]	No. of Suspect Records	No. of Invalid Records	No. of Missing Records
Angiola Trailer (5-minute)	1-16	93,100	93,100	100%	36,407	39%	17,723	17,669	21,301
Angiola Trailer (60-minute)	1-16	7760	7760	100%	3046	39%	1475	1695	1544

[a.] % capture = total number of records/expected records*100
[b.] % recovery = number of valid records/total numbers of records

All bins had a 100% data capture rate. Data recovery was 39% for both 5-minute and 60-minute data. The instrument often failed flow checks and was returned to the manufacturer during the sampling period which resulted in a significant number of missing records.

3. LOWER QUANTIFIABLE LIMIT

The LQL is the lowest concentration in ambient air that can be measured when processing actual samples. Sources of variability that influence the monitored signal at low concentrations include instrument noise and atmospheric variability. As a measure of this variability, two times the standard deviation of selected 5-minute and 60-minute data were used to estimate the LQL. The selected data were taken during periods with concentrations close to the zero and relatively stable. This is a conservative estimate of the LQL because it includes the concentration variability of the ambient air. Twelve consecutive data values were used to compute the LQL with the 5-minute data and six data values with the 60-minute data; atmospheric variation generally becomes too great after six hours to calculate a reasonable LQL. Since only half the number of data values were used in the calculation (see “N” in Equation O-1), the 60-minute LQL is expected to be higher than the 5-minute LQL, despite the “smoothing” that occurs when averaging 5-minute to 60-minute values.

The LQL is calculated as shown in Equation O-1. **Table O-3** shows the 5-minute and 60-minute LQL for selected size bins, as well as the specific data strings used to calculate the LQL.

$$\mathrm{LQL} \approx 2s = 2\sqrt{\frac{\sum (OPC - \overline{OPC})^2}{N-1}} \qquad \textbf{(O-1)}$$

where:

$\overline{OPC}$ = mean OPC count
N = number of measurements
σ = standard deviation

Table O-3. Time period used to calculate LQL, the LQL, and the corresponding mean concentration during the selected time period.

Bin	Type of Data	Start Time Used in LQL Calculation (PST)	LQL Counts/cm^3	Mean Counts/cm^3
1	5-minute	2/11/01 15:15	2.0093	7.1911
2	5-minute	2/11/01 16:00	0.277	1.1848
3	5-minute	1/24/01 12:55	0.0664	0.1153
4	5-minute	2/11/01 15:25	0.0429	0.0805
5	5-minute	1/25/01 3:50	0.0171	0.0369
6	5-minute	1/25/01 4:40	0.0109	0.0139
7	5-minute	1/25/01 3:50	0.0094	0.0022
8	5-minute	6/16/00 10:35	0.0068	0.0019
1	60-minute	2/10/01 16:00	9.7333	55.38
2	60-minute	5/10/00 21:00	0.683	22.5133
3	60-minute	2/10/01 16:00	0.2072	0.6655
4	60-minute	5/8/00 14:00	0.0448	0.1997
5	60-minute	1/25/01 3:00	0.0425	0.0587
6	60-minute	1/25/01 3:00	0.012	0.0196
7	60-minute	2/13/01 19:00	0.0048	0.0326
8	60-minute	1/17/01 0:00	0.0026	0.002

4. ACCURACY

The calibration of the OPCs consisted of a flow check performed at the inlet located on the sampling trailer’s roof, flow checks performed on individual instruments, dynamic zeroes, and polystyrene latex (PSL) checks. Quantitative calibration data were not available for this instrument, nor were flow checks performed regularly enough to calculate a meaningful accuracy of the flow. Therefore accuracy calculations for this instrument are beyond the scope of this report.

Qualitatively, the PSL checks provide an indication of how well the OPCs separated particles of varying sizes. For these checks, moderate concentrations of PSL spheres of known diameter were nebulized and injected in a diluted sample stream. Five spheres of different-sized diameters—4.6 µm, 1.4 µm, 0.89 µm, 0.58 µm, and 0.23 µm—were used. The largest four spheres (0.58-4.6 µm) were measured by the Climet OPC; the smaller four spheres (0.23-1.4 µm) were measured by the PMS Lasair OPC, and the smallest spheres (0.23 µm) were also measured by the Scanning Mobility Particle Sizer (SMPS). The operator verified that the majority of the spheres fell into the correct size bin of a given instrument by recording the counts in the relevant bins and/or by compiling the computer-generated printouts of the bin counts. All of the documented PSL checks on the Lasair OPC, ground-level Climet OPC, and 100-m Climet OPC passed. The few failed PSL checks on the 50-m Climet OPC were attributed to a misaligned laser diode.

5. PRECISION

Precision can be measured for the OPC by evaluating the variance of particle counts during a period of low variability, when atmospheric influence on variability is assumed to be minimal. Five-minute and 60-minute data were selected during periods of low variability, but when concentrations were well above the LQL. The precision was then evaluated by calculating the coefficient of variation (CV) during the period of low variability, as shown in Equation O-2.

$$\mathrm{Pr}\,ecision \approx CV = \frac{s_{measured}}{\left[\overline{OPC}\right]_{measured}} \times 100\% \qquad \textbf{(O-2)}$$

where:

$$s_{measured} = \sqrt{\frac{\sum\left(\left[OPC\right]_{measured} - \left[\overline{OPC}\right]_{measured}\right)^2}{N-1}}$$

All the particle count values in Equation O-2 refer to the counts during the selected time period. **Table O-4** shows the precision for each bin.

Table O-4. Precision, the number of data points, time period and mean of the data used to calculate the precision of the OPC data.

Bin	Interval	No. of Data Points Used	Start Date/Time (PST)	Mean Counts/cm^3	Precision %
1	5-minute	12	1/18/01 14:30	1522.167	1.2
2	5-minute	17	1/27/01 3:20	253.1941	0.7
3	5-minute	12	1/18/01 14:30	459.4167	1.3
4	5-minute	12	1/18/01 14:30	117.0667	1.5
5	5-minute	14	1/18/01 14:40	19.2893	1.7
6	5-minute	15	9/11/00 10:05	1.7728	6.3
7	5-minute	13	9/11/00 9:55	2.1185	5.7
8	5-minute	16	9/18/00 15:45	1.0514	9.8
1	60-minute	6	9/11/00 10:00	1515.5	3.2
2	60-minute	6	5/1/00 10:00	73.9317	2.0
3	60-minute	7	1/9/01 18:00	205.8857	3.0
4	60-minute	6	1/9/01 17:00	58.79	3.5
5	60-minute	8	5/1/00 12:00	1.2365	2.9
6	60-minute	7	1/18/01 15:00	1.3276	1.7
7	60-minute	6	9/17/2000 9:00	0.488	5.2
8	60-minute	6	9/17/00 0700	0.450	12.7

6. REFERENCES

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